

WHAT IS CLAIMED IS:

1. A method for inspecting an exposure apparatus, comprising:

5 a step of guiding light emitted from an illumination optical system to a photomask where a pattern is formed of an optical member including a light transmission pattern as a diffraction grating pattern, in which a light transmission part and a  
10 opaque part are repeated in a predetermined direction, a plurality of ratios are given between a length of the light transmission part and a length of the opaque part in a repetition direction, and a periphery of the light transmission pattern is shielded by a opaque area, such that a plurality of ratios are given between the light  
15 transmission part and the opaque part;

a step of irradiating diffraction light, which has passed through the photomask, on a projection optical system, thereby to transfer a pattern reflecting an intensity distribution of the diffraction light to  
20 a wafer; and

a step of measuring a change of transmittance depending on a light path of the projection optical system, based on a pattern image of the diffraction light transferred to the wafer.

25 2. A method according to claim 1, wherein said pattern transfer is performed in which the photomask and the wafer are non-conjugate with respect to the

projection optical system.

3. A method according to claim 1, wherein, where  
NA is a numerical aperture of the projection optical  
system in a side of the wafer,  $\lambda$  is a exposure length,  
5  $\sigma$  is a coherence factor, and M is a magnification of  
the photomask, the diffraction grating pattern has  
a period which satisfies

$$p > M\lambda / NA(1 + \sigma)$$

4. A method according to claim 1, wherein the  
10 non-conjugate state in which the photomask and the  
wafer are non-conjugate with respect to the projection  
optical system is realized by arranging the opaque part  
of the light optical member on a surface opposite to  
a surface where the optical member of the photomask  
15 used for device pattern exposure is arranged.

5. A method according to claim 1, wherein, where  
a length of a longest line among lengths of lines  
connecting arbitrary two points positioned on a  
boundary to the opaque part, of the opaque part of  
20 the light transmission pattern, is  $2r$ , a thickness of  
the photomask is  $d$ , an exposure wavelength is  $\lambda$ , and  
a refractive index of a material of the photomask at  
the exposure wavelength  $\lambda$  is  $n$ , a relationship of  
 $0.4(nd\lambda)^{1/2} \leq r \leq (nd\lambda)^{1/2}$  is satisfied.

25 6. A method according to claim 5, wherein the  
light transmission pattern is a circular pattern having  
a radius  $r$ .

7. A method according to claim 6, wherein where,  
of the light pattern, an area surrounded by the opaque  
area is expressed  $\pi r^2$ , a thickness of the photomask is  
d, an exposure wavelength is  $\lambda$ , and a material of the  
5 photomask has a refractive index of n, a relationship  
of  $0.4(nd\lambda)^{1/2} \leq r \leq 10(nd\lambda)^{1/2}$  is satisfied.

8. A method according to claim 1, wherein  
the pattern formed on the wafer is made of  
a predetermined material, and

10 the change of the transmittance is measured by  
measuring a film thickness of the pattern transferred  
to the wafer and by obtaining a light intensity of the  
diffraction light, based on a predetermined relation-  
ship between a film thickness of the predetermined  
15 material and an irradiation light intensity.

9. A method according to claim 1, wherein the  
predetermined relationship between the film thickness  
of the predetermined material and the light intensity  
is a sensitivity curve expressing the relationship  
20 between the film thickness of the predetermined  
material and the light intensity.

10. A method according to claim 1, wherein a  
change of the transmittance is measured in a manner  
that a boundary between an area where photoresist was  
25 stripped and an area where photoresist was remained  
is regarded as a equal-intensity contour curve, a  
plurality of equal-intensity contour curves each being

the equal-intensity contour curve are obtained respectively under different conditions, and the plurality of equal-intensity contour curves obtained are layered thereby to obtain an equal-intensity contour plot.

11. A method for inspecting an exposure device, comprising:

a step of guiding light emitted from an illumination optical system to a photomask where a pattern is formed of an optical member including a light transmission pattern as a diffraction grating pattern, in which a light transmission part and a opaque part are repeated in a predetermined direction, a plurality of ratios are given between a length of the light transmission part and a length of the opaque part in a repetition direction, phases of lights which pass through adjacent light transmission parts with the opaque part inserted therebetween differs from each other substantially by  $180^\circ$ , and a periphery of the light transmission pattern is shielded by a opaque area, such that a plurality of ratios are given between the light transmission part and the opaque part;

a step of irradiating diffraction light, which has passed through the photomask, onto a projection optical system, thereby to transfer the pattern to a wafer and to form a pattern reflecting an intensity distribution of the diffraction light; and

a step of measuring a change of transmittance depending on a light path of the projection optical system, based on a pattern image of the diffraction light transferred to the wafer.

5        12. A method according to claim 11, wherein said pattern transfer is performed in which the photomask and the wafer are non-conjugate with respect to the projection optical system.

10        13. A method according to claim 11, wherein the pattern formed on the wafer is made of a predetermined material, and

the change of the transmittance is measured by measuring a film thickness of the pattern transferred to the wafer and by obtaining a light intensity of the diffraction light, based on a predetermined relationship between a film thickness of the predetermined material and an irradiation light intensity.

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14. A method according to claim 11, wherein the predetermined relationship between the film thickness of the predetermined material and the light intensity is a sensitivity curve expressing the relationship between the film thickness of the predetermined material and the light intensity.

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15. A method according to claim 11, wherein a change of the transmittance is measured in a manner that a boundary between an area where photoresist was stripped and an area where photoresist was remained

25

is regarded as a equal-intensity contour curve,  
a plurality of equal-intensity contour curves each  
being the equal-intensity contour curve are obtained  
respectively under different conditions, and the  
5 plurality of equal-intensity contour curves obtained  
are layered thereby to obtain an equal-intensity  
contour plot.

16. A method for inspecting an exposure device,  
comprising:

10 a step of guiding light emitted from an  
illumination optical system to a photomask where  
a pattern is formed of an optical member including  
a light transmission pattern as a diffraction grating  
pattern, in which a first light transmission part and  
15 a second light transmission part having a lower  
transmittance than the first light transmission part  
are repeated in a predetermined direction, a plurality  
of ratios are given between lengths of the first and  
second light transmission parts in a repetition  
20 direction, phases of lights which pass through the  
first and second light transmission parts adjacent to  
each other differ from each other, and a periphery of  
the light transmission pattern is shielded by a opaque  
area, such that a plurality of ratios are given between  
25 the light transmission part and the opaque part;

a step of irradiating diffraction light, which has  
passed through the photomask, onto a projection optical

system, thereby to transfer the pattern to a wafer and to form a pattern reflecting an intensity distribution of the diffraction light; and

5 a step of measuring a change of transmittance depending on a light path of the projection optical system, based on a pattern image of the diffraction light transferred to the wafer.

17. A method according to claim 16, wherein said pattern transfer is performed in which the photomask  
10 and the wafer are non-conjugate with respect to the projection optical system.

18. A method according to claim 16, wherein the pattern formed on the wafer is made of a predetermined material, and

15 the change of the transmittance is measured by measuring a film thickness of the pattern transferred to the wafer and by obtaining a light intensity of the diffraction light, based on a predetermined relationship between a film thickness of the predetermined  
20 material and an irradiation light intensity.

19. A method according to claim 16, wherein the predetermined relationship between the film thickness of the predetermined material and the light intensity is a sensitivity curve expressing the relationship  
25 between the film thickness of the predetermined material and the light intensity.

20. A method according to claim 16, wherein

a change of the transmittance is measured in a manner  
that a boundary between an area where photoresist was  
stripped and an area where photoresist was remained  
is regarded as a equal-intensity contour curve,  
5 a plurality of equal-intensity contour curves each  
being the equal-intensity contour curve are obtained  
respectively under different conditions, and the  
plurality of equal-intensity contour curves obtained  
are layered thereby to obtain an equal-intensity  
10 contour plot.